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TRANSPLANTING SEEDLINGS INTO CONTAINERS MAY CAUSE ROOT DEFORMATIONS

by

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CATEGORY: Silviculture

KEY WORDS: Black spruce, jack pine, container stock, paperpots, root morphology, transplanting, growth

INTRODUCTION

Transplanting germinants and young seedlings into empty cavities ("pricking-out") is commonly practiced in container-seedling culture to ensure full tray stocking during the nursery phase and at shipping. The practice is labor-intensive and time consuming, and there are concerns that it may lead to poor growth (Carlson 1979) and that root-system aberrations might develop as a result of careless transplanting or the effects of transplanting seedlings with excessive root development.

Transplanting can be justified only if the results are biologically acceptable. In 1988 a greenhouse study was undertaken to evaluate the effect upon growth and root development of transplanting spruce and pine seedlings, at different stages in their development, into Japanese paperpots. A detailed report on all aspects of the study has been published (Scarratt 1991); this note provides highlights only.

METHODS

Black spruce (*Picea mariana* [Mill.] B.S.P.) and jack pine (*Pinus banksiana* Lamb.) seedlings were transplanted into and grown in trays of FH408 Japanese paperpots filled with a 2:1 peat moss:horticultural-grade vermiculite mixture. The experiment examined five treatments based on the stage of seedling development at the time of transplanting, viz.: (1) erect hypocotyl, (2) expanded cotyledon, (3) primary-needle initiation (>1 mm), (4) 7 days after primary-needle initiation, and (5) 14 days after primary-needle initiation. Operational transplanting generally takes place at stages 2 through 4.

Control trays were sown and covered with grit in the normal manner. Seedlings to be transplanted were grown on adjacent benches under similar conditions to the controls. All trays were sown on 11 June, and were watered and fertilized by means of a travelling-boom sprayer.

Treatment seedlings were pricked-out into preassigned trays when a sufficient number had reached the specified stage of development to allow completion of a transplanting treatment in one day (Table 1).

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Table 1. Stages of seedling development at the time of transplanting.

Transplanting stage	Elapsed time (days from germination) Black spruce	Jack pine
Erect hypocotyl	0	0
Expanded cotyledons	6	5
Primary-needle initiation	13	10
Primary-needle + 7 days (PN+7)	20	17
Primary-needle + 14 days (PN+14)	27	24

Once a full tray of seedlings had been transplanted, the growing medium was covered with a thin layer of silica grit and the tray was returned to its original position within the experiment. All trays of pine were moved outdoors at 16 weeks, but the spruces were kept in the greenhouse under natural daylength.

Seedlings were sampled for growth and dry weight at 12 and 16 weeks. Further samples were taken at 24 weeks to allow an evaluation of root morphology.

A number of seedlings were transplanted into clay pots at the time of the final sample to provide information on subsequent root development. These seedlings were grown for a further 26 weeks in the greenhouse before their roots were examined.

RESULTS

Transplanting

The difficulty of transplanting increased considerably between the first and last treatments. At the erect-hypocotyl stage, both species could be transplanted without difficulty, but their small size and fragility made for a tedious operation, particularly for spruce.

By the time of primary-needle initiation, 5 days later, the length of the jack pine primary roots made transplanting more difficult and time consuming. Even careful transplanters found it difficult to avoid kinking or twisting roots. Black spruce roots were shorter, and seedlings could still be transplanted without too much difficulty.

Seven days after primary-needle initiation (PN+7), jack pine seedlings had developed numerous lateral roots; they were difficult to remove from the growing medium without damage, and were very difficult to transplant. Root development was less advanced in black spruce, but sufficient to make transplanting difficult. By 14 days after primary-needle initiation (PN+14), further root development exacerbated the difficulty of transplanting both species.

Root Morphology and Seedling Growth During the Initial Growth Phase

Transplanting had significant effects on root system morphology, particularly at the later transplanting dates (Fig. 1). Of seedlings transplanted at the time of primary-needle initiation, only 35% exhibited normal/acceptable root development. The frequency of twisted roots and J-roots (Fig. 2) reflected the difficulties in transplanting older seedlings rather than the effects of damage to the root system *per se*. Jack pine, with its larger root system, was more seriously affected than black spruce. In the last two transplanting treatments, two-thirds of all pine and half of the spruce seedlings bore J-roots. However, transplanting had only minor effects on seedling size at the end of typical greenhouse production cycles (Table 2).

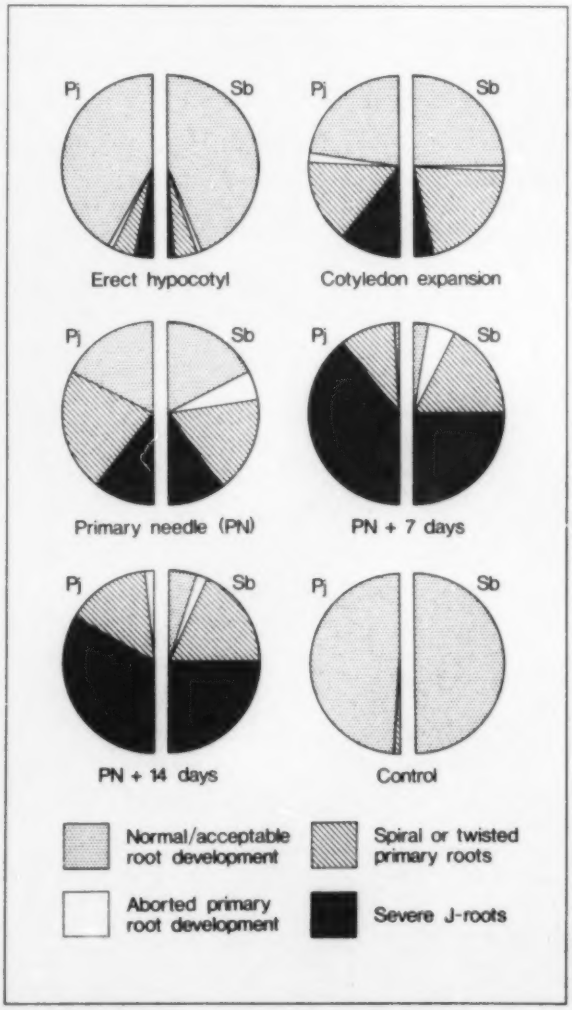

Figure 1. Incidence of root aberrations in jack pine (Pj) and black spruce (Sb) seedlings transplanted at five different stages of development (n=60).

Figure 2. Severe J-root deformity in jack pine, reflecting the difficulties involved in transplanting older seedlings.

Root Development In Clay Pots

The small sample of seedlings planted in clay pots produced no evidence to suggest that transplanting had any effects on seedling growth or development of new roots after planting. All seedlings of both species developed extensive new root systems that extended outside the container. However, transplanted seedlings exhibited some degree of swelling and root deformation at the root base (Fig. 3) within the original container. These abnormalities were most severe in jack pine, where they were usually associated with the absence of tap root development.

RECOMMENDATIONS AND CONCLUSIONS

In this study, transplanting did not have major adverse effects on seedling growth. However, in an operational setting, less careful transplanting might have more serious consequences. The following optimum practical transplanting windows should not be exceeded: about 8 days for jack pine (erect-hypocotyl stage to a few days after cotyledon expansion, but preferably before primary-needle initiation) and 10 days for black spruce (cotyledon expansion to a few days after primary-needle initiation). Special care should be taken to not damage or break the primary root when pricking-out seedlings, especially with jack pine. Although such injury was infrequent, it was associated with aborted tap root development.

Table 2. Effect of transplanting date on shoots and roots of 12-week-old jack pine and 16-week-old black spruce seedlings (n=40).

		Transplanting date (stage) [a]				
	Control	1	2	3	4	5
				Jack pine		
Shoot height (mm)	13.5	13.9	14.5	14.8	15.1	15.2
Shoot dry weight (mg)	245	201	172*	214	235	237
Root dry weight (mg)	44	24*	25*	36	36	37
Total dry weight (mg)	289	225	197*	250	271	284
Shoot:root ratio	6.0	8.6	7.4	5.4	6.7	6.4
				Black spruce		
Shoot height (mm)	17.7	17.7	17.9	18.5	18.1	16.5
Shoot dry weight (mg)	349	355	370	341	359	305
Root dry weight (mg)	44	42	47	45	41	34*
Total dry weight (mg)	393	397	417	386	400	339
Shoot:root ratio	8.1	8.3	7.8	7.7	8.7	9.1

[a] 1 = erect hypocotyl; 2 = expanded cotyledons; 3 = primary-needle initiation; 4 = 7 days after primary-needle initiation; 5 = 14 days after primary-needle initiation. Note: means marked with an asterisk differ significantly from those of the control ($p = 0.05$, Dunnett's test).

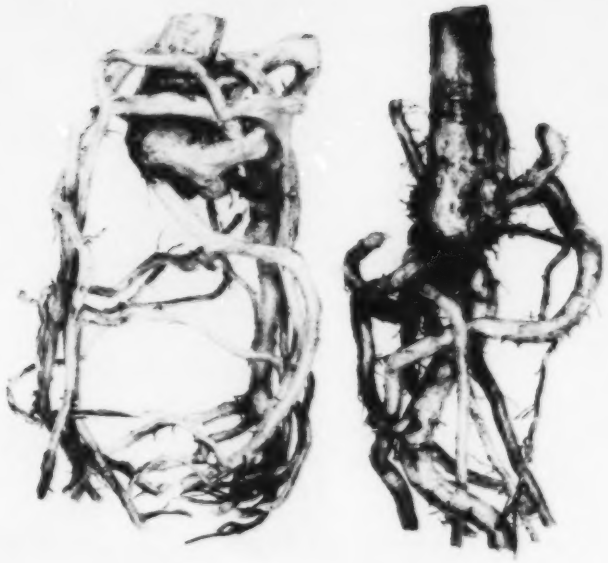

Figure 3. Swelling and root deformation at the base of jack pine (left) and black spruce (right) 26 weeks after planting in clay pots. Note the absence of a tap root in jack pine.

Transplanting caused root deformities in both species. Although these had no apparent ill effects on seedling performance after planting, the possibility of long-term effects cannot be discounted. Transplanting is not recommended as a routine practice for the wholesale restocking of blank cavities in trays of containerized seedlings, particularly of jack pine. Potential long-term biological risks, practical difficulties and high labor costs render the practice undesirable.

REFERENCES AND FURTHER READING

Carlson, L.W. 1979. Guidelines for rearing containerized conifer seedlings in the Prairie Provinces. Dep. Environ., Can. For. Serv., Edmonton, Alta. Inf. Rep. NOR-X-214. 64 p.

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Dr. John Scarratt studies the production and performance of containerized planting stock.

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